International Journal For Technological Research In Engineering
Volume 9, Issue 10, June-2022 *ISSN (Online): 2347 - 4718*

DEVELOPMENT OF LANDUSE LANDCOVER AND CHANGE DETECTION ANALYSIS OF APCRDA USING REMOTE SENSING AND GIS

Dr. K.Sundara Kumar[1], Boosi Vikram Dani[2], Dasari Bala Kiran[3], Cherukuri Jayachandra[4], Kolusu Dhanarji Sai[5]
[1]Professor & HOD, C.E Dept, [2,3,4,5] B.tech IV year Student
C.E Department
Usharama College of Engineering& Technology, Telaprolu, Krishna District, Andhra Pradesh, India

Abstract:* Accelerated urbanization will create several challenges, including reductions in green space, water shortage, air pollution, solid waste disposal problem, and associated environmental issues. Specific problems associated with unplanned rapid urbanization include large-scale land-cover changes, disturbance in ecological balance, degradation of the environment, over consumption of resources, changes in local or micro climate and development of urban heat islands, soil erosion, changes in the hydrological cycle which is impairing surface water and ground water regime and so on. This would eventually lead to unsustainable growth and over a period of time, urban dwelling may become a wretched one in the future. By processing the satellite imagery, LULC maps of the study area for 1990, 1995, 2000, 2005, 2010 and 2020 were developed with supervised classification with the maximum likely hood algorithm in image-processing software ERDAS. The field data from 100 places supplemented the classification process, and the overall accuracy was obtained as 93% for the year 2020. Total study area considered is a rectangular area covering 603989 hectares, which is about 80% of the capital region proposed by AP CRDA. The changes in LULC were studied from 1990 to 2020 and the found that there is a considerable increase in Built-up area by about 541.5%. Barren land increased by 70.2% and open area with dry fields increased by 161.5%. On the other hand, there is a considerable decrease in the agriculture land with light vegetation by 46% and forest with dense tree clad area got decreased by about 19.5% in these 30 years.

Keywords — Urban expansion, Satellite Imagery, LULC, Change Detection, Remote sensing.

I. INTRODUCTION

Wide-spread urbanization is attracting and concentrating this population into dense settlements because of the promising economic conditions. However, the resources may not sustain the sudden over burden pressures and integrity of the physical environment of the urban areas gradually collapses. Urban areas supporting large number of population of any region are also act as ecosystems, which are maintaining the sustainability of the society. These urban ecosystems are the places where high consumption of resources and disproportionate utilization of natural resources. These natural resources and services are provided by the surrounding suburban areas and villages. Inflow of large amounts of products and goods takes place in these urban ecosystems more or less in a unidirectional way. There will be no return back of these products or services. As a result waste accumulation and subsequent pollution is caused. Air pollution, water pollution, soil pollution, noise pollution, solid waste nuisance, leachate problem, health problems caused by hazardous wastes including biomedical, chemical and radioactive wastes, etc are some of the effects of urbanization.

In addition to the disruption of ecological balance and contribution to severe pollution, urbanization also has impacts on several geological elements in regional scales. Urban sprawl is likely to escalate and will have a profound effect on environmental conditions and processes. Apart from the general challenges like land-use planning, housing and infrastructure, pollution and development, urbanization is believed to have serious implications like changes in microclimate, regional-scale climatic changes and potential sea-level rise. This is the major component of the anthropogenic climatic changes which draws attention worldwide.

Conversion of land surface from vegetative cover to concrete and built-up surfaces decreases the infiltration capacity and increases the runoff characteristic which is the main cause of the inundation or flooding even due to short spell of rains. Changes in evaporative characteristics of the land surface leads to heat retaining capacities and contributes to the rising temperatures of the area.

The natural vegetative cover which is having low albedo absorbs sunlight and utilise it for production of glucose and keeps the surface cooler. The evapo-transpiration from the leaves help dissipating the heat energy to the air above. Similarly a moist soil also transpires and keeps the surrounding temperature cool. On the other hand, the rock surfaces, concrete, bitumen top roads do not transpire, resulting in unusual disturbance in the surface heat balance which eventually cause heat islands.

Understanding of the relations between the urban systems, micro climates and global-scale climates becomes the focal point of the current research related o urbanization. Ensuring a pleasant and healthy living environment for inhabitants without any repercussions from any large-scale changes is the major objective of any city planner. Urban morphology and environmental conditions are continuous processes, and hence constant long-term environmental monitoring is essential for devising any effective mitigation measure.

Remote-sensing play a vital role in this field by providing invaluable tools for the long-term monitoring of the urban surface processes. Synoptic view, cost-effectiveness, non-destructiveness, repetitive data collection, high spatial resolution, digital format, acquisition of imagery from inaccessible locations without any hindrance of political or security restrictions, are the main advantages of the remote-sensing applications.

Also GIS technology provides an excellent flexible environment for processing, storing, analyzing, and displaying digital data, necessary for land-use-land-cover change detection and database development.

II. STUDY AREA & DATA

APCRDA
After bifurcation of Andhra Pradesh State in to two separate states, viz, Andhra Pradesh and Telangana, a new state of Andhra Pradesh with 13 districts was declared in the year 2014. Subsequently, the government of Andhra Pradesh formed an urban planning agency called "Andhra Pradesh Capital Region Development Authority" (APCRDA) and notified on December 30th, 2014 to look after the construction and development of the capital region. This APCRDA, replaces the existing government agency "Vijayawada-Guntur-Tenali-Mangalagiri Urban Development Authority" (VGTMUDA) which is intended for the development of the four city quadrant.

The Capital Region spreads over and area of 8,603.32 Sq.km spanning on both sides of the Krishna River in the adjacent districts of Krishna and Guntur. The extent of the region is spread across 58 mandals, of which 29 are in Krishna district and 29 in Guntur district. The capital region covers 18mandals fully and 11 mandals partially in Guntur district. In Krishna district, it covers 15 mandals fully and 14mandals partially under the jurisdiction of APCRDA. Within this new capital region, several infrastructural projects were already proposed like, Infrastructure development, Housing development, Commercial development, Health care projects, Education Projects, Tourism and Recreation projects, Manufacturing projects and other support and service projects.

Satellite Imagery
To carry out the present investigation on the changes occurred in the selected study area from the past to present, the following satellite images were used. The hi-resolution, multispectral, multi temporal satellite imagery obtained from Landsat were procured from the United States Geological Survey's(USGS), data dissemination portal called "Earth explorer" (https://earthexplorer.usgs.gov/). The complete details regarding the Landsat imagery are presented in the Table 1 given below:

Table 1: Details of satellite imagery used

ACQUISITIO N DATE	SENSO R	SATELLI TE	PASS TIME (GMT)	REF-SYSTE M	PATH/ ROW
23-05-2020	OLI-TIRS	Landsat-8	04:56:46	WRS -II	142/49
26-06-2010	TM	Landsat-5	04:48:17	WRS -II	142/49
11-05-2005	TM	Landsat-5	04:44:58	WRS -II	142/49
28-10-2000	TM	Landsat-5	04:48:02	WRS -II	142/49
29-03-1995	TM	Landsat-5	04:07:22	WRS -II	142/49
03-06-1990	TM	Landsat-5	04:17:53	WRS -II	142/49

III. METHODOLOGY

PREPARATION OF BASE MAP:
Firstly, the collected topo-sheets were used to prepare a mosaic containing the study area and required area is clipped as a rectangular image. It was used to prepare a base map of the study area, which gives the idea about different features of the study area. The base map depicts the topographical features of the study area which include river course, forests, hills and mountains, railway tracks and all other features which are relatively stable, that means do not undergo considerable change in due course of time.

CLASSIFICATION OF SATELLITE IMAGES:
Next, the satellite images procured for the study area are processed by Mosaic, Stacking, and Histogram Equalization using image processing software called ERDAS. After processing of the imagery, the required study area is extracted by sub-setting or clipping. Now the produced images were subjected to land use land cover classification process using supervised classification technique.

In this supervised classification process, the computer is assisted by user's field knowledge regarding the identification of the different classes of the land cover. Different training sites will be selected for known classes of land cover and fed to the computer so that it is trained for classification. There are seven types of LULC classes significantly identified in the study area based on extensive field survey carried out. The following table describes the classes of LULC.

Table.2: Land use Land Cover types observed in the study area.

Class Number	LAND USE TYPE	Abbreviation used
1	WATER BODIES - WET LANDS	WW
2	SAND - RIVER COURSE	SR
3	BUILT UP - RURAL & URBAN	BU
4	FOREST - DENSE TREE CLAD AREA	FD
5	AGRICULTURE LAND - LIGHT VEGETATION	AL
6	BARREN LAND - ROCKY AREA	BR
7	OPEN AREA - DRY FIELDS	OD

SUPERVISED CLASSIFICATION:
From the supervised classification methods in ERDAS Imagine, the parallelepipeds maximum likelihood (Para-ML)

classification algorithm was used to produce the land cover maps. The Para-ML method combines parallelepiped and maximum likelihood classification methods, and uses a decision rule to evaluate each pixel. The parallelepiped classification is based on a set of lower and upper threshold reflectance determined for a signature on each band. To be assigned to a particular class, a pixel must exhibit reflectance within this reflectance range for every band considered. Pixels that are assigned to more than one class are then passed to the maximum likelihood decision rule for assignment to a single class. Those classes that couldn't be identified in any other way were manually digitized over the images. The final land cove maps produced using these procedures enabled spatio-temporal change analysis and pattern through change maps and spatial metrics.

The detailed procedure is depicted in the following flow chart given below.

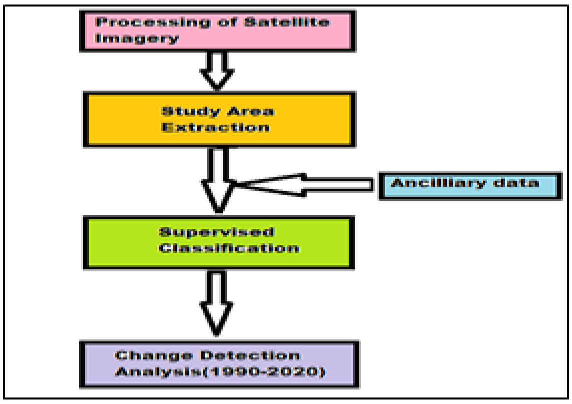

Fig.1: Methodology adopted for change detection analysis

IV. RESULTS & DISCUSSION

To study the urban sprawl change detction analysis was performed on LULC images developed from 1990 to 2020. The increase in urban area commonly known as urban sprawl is clearly identfied. Hence it is very essential to study the LULC images to identify the presence of urban sprawl. For this purpose all the developed LULC images from 1990 to 2020 are presented in the following figures:

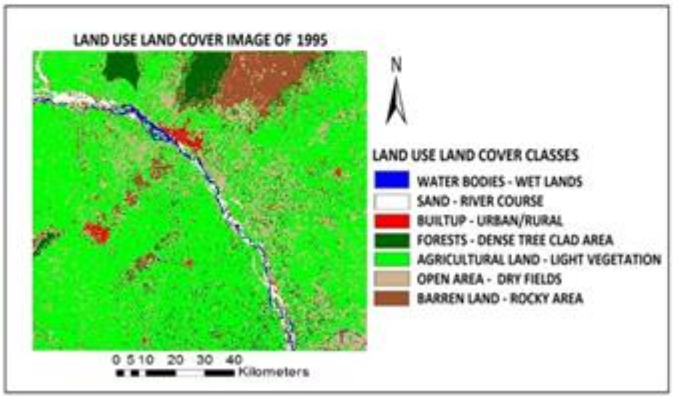

Figure 2: Land Use Land Cover Map for the year 1990

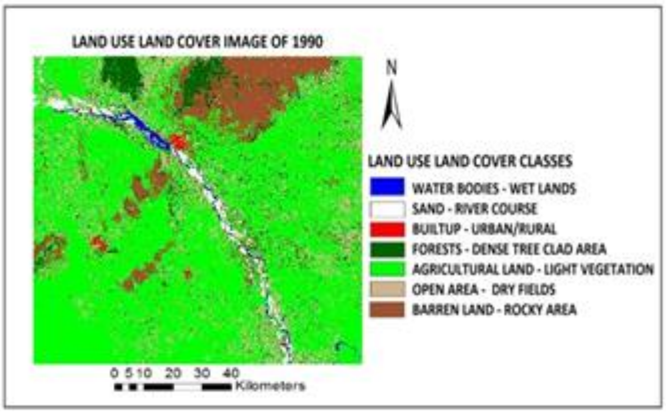

Figure 3: Land Use Land Cover Map for the year 1995

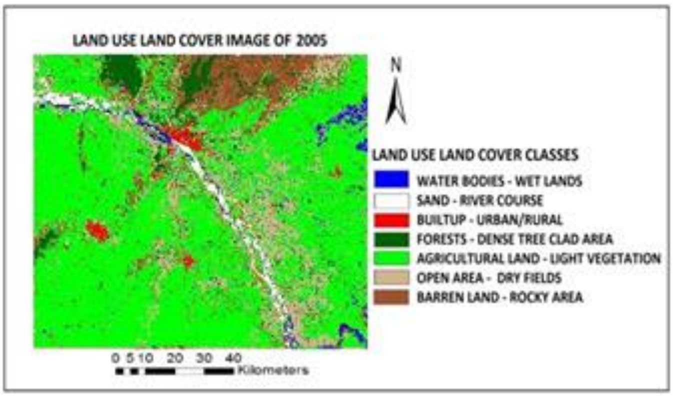

Figure 4: Land Use Land Cover Map for the year 2000

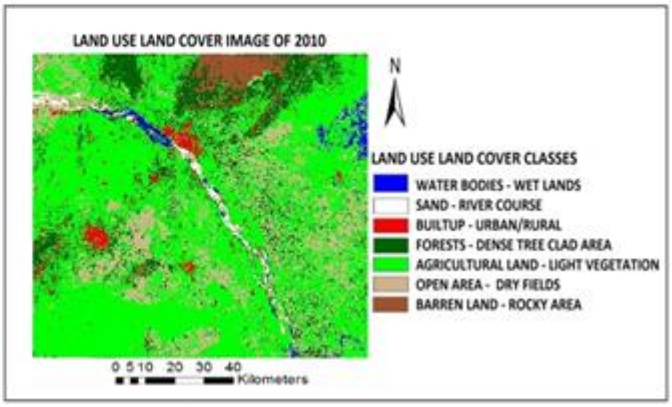

Figure 5: Land Use Land Cover Map for the year 2005

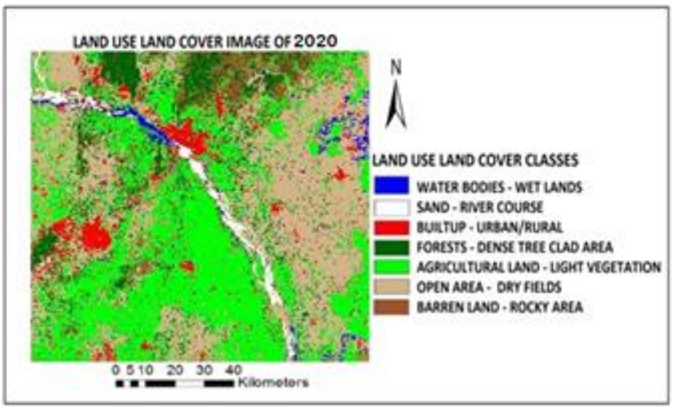

Figure 6: Land Use Land Cover Map for the year 2010

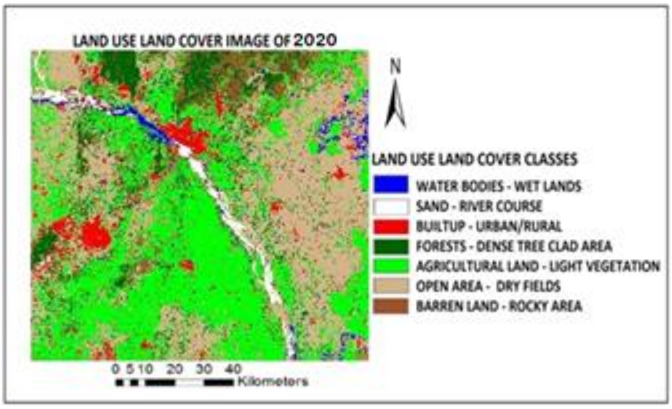

Figure 7: Land Use Land Cover Map for the year 2020

Change Detection Analysis

After the development of LULC images of the years 1990, 1995, 2000 2005, 2010 and 2020, and asserting the classification accuracies in acceptable ranges, the areas of different classes were calculated in Hectares and presented in the following Table 5.4 for carrying out the change detection analysis.

Table 3: Areas of LULC from 1990 to 2020

LAND USE TYPE	Area in Hectares	
Year--->	1990	2020
WW	6006	11489
SR	11755	12865
BU	6012	38566
FD	74801	60179
AL	392816	212060
OD	28011	47665
BR	84588	221165
TOTAL	603989	603989

(WW- WATER BODIES - WET LANDS, SR- SAND - RIVER COURSE, BU- BUILT UP - RURAL & URBAN, FD- FOREST - DENSE TREE CLAD AREA, AL- AGRICULTURE LAND - LIGHT VEGETATION, OD- OPEN AREA - DRY FIELDS, BR- BARREN LAND - ROCKY AREA)

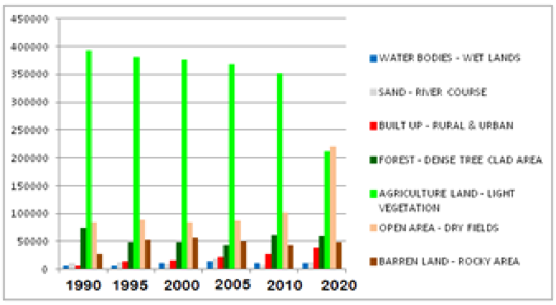

Figure 8: The Changes in areas in LULC of 1990 to 2020

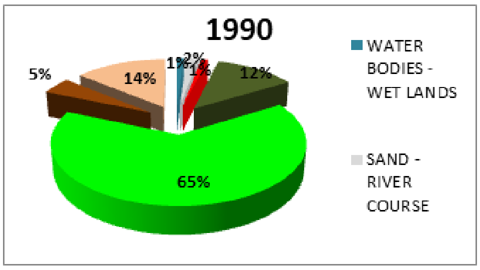

Figure 9: The Distribution of areas of LULC in the year 1990

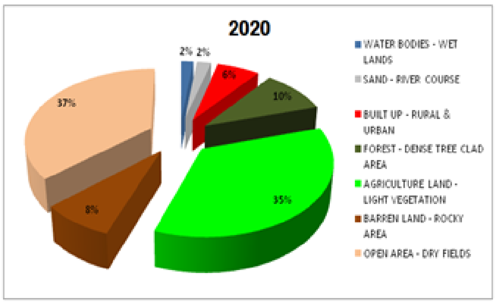

Figure 10: The Distribution of areas of LULC in the year 2020

The changes occurred in the LULC types of the study area from 1990 to 2020 were calculated and presented in the following table.

Table 4:Change detection in LULC from 1990 to 2020

LAND USE TYPE	Area in Hectares in 1990	Area in Hectares in 2020	Difference Area in Hectares 1990-2020	% Change in Area
WATER BODIES - WET LANDS	6006	11489	5483	91.3
SAND - RIVER COURSE	11755	12865	1110	9.4
BUILT UP - RURAL & URBAN	6012	38566	32554	541.5
FOREST - DENSE TREE CLAD AREA	74801	60179	-14622	-19.5
AGRICULTURE LAND - LIGHT VEGETATION	392816	212060	-180756	-46.0
BARREN LAND - ROCKY AREA	28011	47665	19654	70.2
OPEN AREA - DRY FIELDS	84588	221165	136577	161.5
TOTAL	603989	603989	0	0

From the above table it is clearly understood that during the 30 years of span, major changes were occurred in the Built up area class and its percentage change is 541.5%. That means Built up are increased to more than five times during the study period. This is because of continuous increase of population and urbanization that has been taken place from 1990 to 2020. Another major change that is noticed is in Open area which depicts the dry fields or abandoned lands, or agricultural lands converted in to open lands before construction of any building. Its percentage increase is 161.5%.

In this chapter, spatio-temporal changes of land use and land cover in the capital region proposed by AP CRDA were estimated with the help of satellite imagery, and change detection analysis was presented. It was concluded that there is a significant decrease in green cover and increase in Built-up area which is going to have severe environmental implications in future.

V. CONCLUSIONS

By processing the satellite imagery, LULC maps of the study area for 1990, 1995, 2000, 2005, 2010 and 2020 were developed with supervised classification with maximum likely hood algorithm in image processing software ERDAS.
The field data from 100 places supplemented the classification process and the overall accuracy was obtained as 93% for the year 2020.
Total study area considered is a rectangular area covering 603989 hectares which is about 80% of the capital region proposed by AP CRDA.
The changes in LULC were studied from 1990 to 2020 and the found that there is a considerable increase in Built-up area by about 541.5%.
Barren land increased by 70.2% and open area with dry fields increased by 161.5%.
On the other hand there is a considerable decrease in the agriculture land with light vegetation by 46% and forest with dense tree clad area got decreased by about 19.5% in these 30 years.
This is mainly due to the population expansion and corresponding thrust on the construction of residential and infrastructural establishments.
It was concluded that there is a significant decrease in green cover and increase in Built-up area which is going to have severe environmental implications in future.

REFERENCES

1. Fenglei Fan , Qihao Weng and Yunpeng Wang, (2007), Land Use and Land Cover Change in Guangzhou, China, from 1998 to 2003, Based on Landsat TM /ETM+ Imagery, Sensors,7, 1323-1342.
2. Ramachandra, T.V. (2008), Regional land cover mapping using remote sensing data, Journal of Agricultural, food and environmental sciences, 2(1), 1-15.
3. M. Cetin, (2009), A satellite based assessment of the impact of urban expansion around a lagoon, Int. J. Environ. Sci. Tech., 6 (4), 579-590.
4. Rahman, Md. Rejaur, Shi,Z.H, and Chongfa, C., (2009), Land Use/Land Cover Change Analysis Using Geo-Information Technology: Two Case Studies In Bangladesh And China, International Journal Of Geoinfomatics, Vol. 5, No.2, 7758-7762.
5. Md. Surabuddin Mondal, Nayan Sharma , Martin Kappas and P. K. Garg, (2015), Critical Assessment of Land Use Land Cover Dynamics Using Multi-Temporal Satellite Images, Environments, 2, 61-90.
6. K. Sundara kumar, M. Harika, Sk. Aspiya Begum, S. Yamini, K. Balakrishna (2012), Land Use And Land Cover Change Detection And Urban Sprawl Analysis Of Vijayawada City Using Multitemporal Landsat Data, International Journal of Engineering Science and Technology, Vol. 4, No.01,170-178.
7. B. Bhatta ,S. Saraswati , D. Bandyopadhyay. (2010). Urban sprawl measurement from remote sensing data. Applied Geography,30,731–740.
8. Mahdi Sabet Sarvestani, Ab. Latif Ibrahim, Pavlos Kanaroglou. (2011). Three decades of urban growth in the city of Shiraz, Iran: A remote sensing and geographic information systems application. Cities,28, 320–329.
9. Abubakr A. A. Alsharif & Biswajeet Pradhan, (2014). Urban Sprawl Analysis of Tripoli Metropolitan City (Libya) Using Remote Sensing Data and Multivariate Logistic Regression Model. Indian Society of Remote Sensing, 42(1),149–163.
10. Shaily Raju Gandhi, Shashikant A. Sharma and Anjana Vyas, (2015), Urban growth analysis using Shannon entropy- A case study of Rajkot city, Journal of Geomatics, Vol 9, No.1, 72-76.
11. Bassam Saleh and Samih Al Rawashdeh, (2007), Study of Urban Expansion in Jordanian Cities Using GIS and Remote Sensing, International Journal of Applied Science and Engineering, 5, 1: 41-52.
12. H.S. Sudhira , T.V. Ramachandra , K.S.Jagadish, (2004), Urban sprawl: metrics, dynamics and modelling using GIS, International Journal of Applied Earth Observation and Geoinformation, 5 ,29–39.
13. M. Alkan & M. Oruc, Y. Yildirim, D. Z. Seker K. Jacobsen.(2013). Monitoring Spatial and Temporal Land Use/Cover Changes; a Case Study in Western Black Sea Region of Turkey. Indian Society of Remote Sensing, 41(3),587–596.

